

## Claims

- [c1] 1. A gap-filling process, comprising the steps of: providing a substrate having a dielectric layer thereon, wherein the dielectric layer has an opening therein; forming a gap-filling material layer over the dielectric layer and inside the opening; removing a portion of the gap-filling material from the gap-filling material layer to expose the dielectric layer; and conducting a gap-filling material treatment on the gap-filling material layer and the dielectric layer.
- [c2] 2. The gap-filling process of claim 1, wherein the gap-filling material treatment includes etching the dielectric layer and the gap-filling material layer to remove a portion of the dielectric layer and the gap-filling material layer and hence planarizing the gap-filling material layer.
- [c3] 3. The gap-filling process of claim 1, wherein the gap-filling material treatment includes forming a protective layer over the gap-filling material layer by conducting a plasma treatment, an ultra-violet curing or a chemical immersion.
- [c4] 4. The gap-filling process of claim 1, wherein steps for treating the gap-filling material include: etching the dielectric layer and the gap-filling material layer; and forming a protective layer over the gap-filling material layer by conducting a plasma treatment, an ultra-violet curing or a chemical immersion.
- [c5] 5. The gap-filling process of claim 1, wherein the step of removing a portion of the gap-filling material from the gap-filling material layer includes etching or chemical-mechanical polishing.
- [c6] 6. The gap-filling process of claim 1, wherein material constituting the gap-filling material layer is selected from a group consisting of l-line photoresist, deep ultra-violet photoresist and bottom anti-reflection coating.
- [c7] 7. The gap-filling process of claim 1, wherein the step of forming the gap-filling material layer includes spin coating.
- [c8] 8. The gap-filling process of claim 1, wherein after the step of treating the gap-filling material on the gap-filling material layer and the dielectric layer, further includes forming a bottom anti-reflection coating over the gap-filling material

layer and the dielectric layer.

- [c9] 9. The gap-filling process of claim 1, wherein the opening is selected from a group consisting of a via opening, a contact opening, a trench and a dual damascene opening.
- [c10] 10. A gap-filling process for fabricating a dual damascene structure, comprising the steps of: providing a substrate; sequentially forming a protective layer, a first dielectric layer, an etching stop layer, a second dielectric layer and a cap layer over the substrate; forming a via opening passing through the first dielectric layer, the etching stop layer, the second dielectric layer and the cap layer; forming a gap-filling material layer over the cap layer and inside the via opening; removing a portion of the gap-filling material from the gap-filling material layer to expose the cap layer; and conducting a gap-filling material treatment on the gap-filling material layer and the cap layer.
- [c11] 11. The gap-filling process of claim 10, wherein the gap-filling material treatment includes etching the cap layer and the gap-filling material layer to remove a portion of the cap layer and the gap-filling material layer and hence planarizing the gap-filling material layer.
- [c12] 12. The gap-filling process of claim 10, wherein the gap-filling material treatment includes forming a protective layer over the gap-filling material layer by conducting a plasma treatment, an ultra-violet curing or a chemical immersion.
- [c13] 13. The gap-filling process of claim 10, wherein steps for treating the gap-filling material includes: etching the cap layer and the gap-filling material layer; and forming a protective layer over the gap-filling material layer by conducting a plasma treatment, an ultra-violet curing or a chemical immersion.
- [c14] 14. The gap-filling process of claim 10, wherein the step of removing a portion of the gap-filling material from the gap-filling material layer includes etching or chemical-mechanical polishing.
- [c15] 15. The gap-filling process of claim 10, wherein the step of forming the gap-

filling material layer includes spin coating.

[c16] 16. The gap-filling process of claim 10, wherein material constituting the gap-filling material layer is selected from a group consisting of I-line photoresist, deep ultra-violet photoresist and bottom anti-reflection coating.

[c17] 17. The gap-filling process of claim 10, wherein after the step of treating the gap-filling material on the gap-filling material layer and the cap layer, further includes forming a bottom anti-reflection coating over the gap-filling material layer and the dielectric layer.